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Filed : March 1, 2002

REMARKS

In the Office Action, the Examiner has rejected claims 1 and 12-16 under 35 U.S.C. § 102(b) as being anticipated by Kelly (U.S. Patent No. 5,894,981). The Applicant has carefully reviewed the Kelly reference and notes that Kelly discloses various versions of an integrated pull tester and ultrasonic wire bonder. The Applicant notes that while certain elements of the Kelly reference are also present in the Applicant's invention, such as a wire bonder, wire clamp, transducer, and drive mechanism for vertical displacement of a bonding head and tool holder, Kelly lacks certain other elements of the Applicant's claimed invention.

More particularly, the Applicant finds no teaching or suggestion of a method of measuring tensile force during a pull test operation or inclusion of a measurement device capable of performing such force measurements. The Applicant finds only description of a position sensor 86 for positioning of the bonding tool 26 as it pivots around pivot point 74 (see column 5, lines 25, 26) and a linear variable differential transducer 90 that can be substituted by a capacitance sensor, a Hall effect sensor, optical sensors, or linear encoders to determine the position of the horn 70 and the attendant bonding tool 26. These position sensors clearly do not constitute force sensors capable of performing tensile force measurements. The Applicant further notes that Kelly fails to disclose or suggest a real time quality control system including in process adjustment of bonding parameters based on the tensile force measurements performed immediately following the formation of the wire bond.

The Examiner also rejects claims 1-5, 8-10, 12-26, 29 and 30 under 35 U.S.C. § 102(b) as being anticipated by Price et al. (U.S. Patent No. 5,591,920). The Applicant has carefully reviewed the Price reference and notes that Price teaches a wire bond pull tester adapted to perform wire bond pull testing in a destructive or non-destructive manner. Figure 4 of Price illustrates a stress vs. strain diagram obtained for various values of drive current I to a Z drive motor 10 to increase the pull force on the bonding wire. Fixed levels of current are applied in increasing increments to the Z drive motor 10. Elongation of the wire is substantially linear until it reaches a distortion shown at approximately 38 where the elongation for the same increment of current causes a larger increase in strain or elongation. Between points 36 and 39, the linear motor 10 is in a forced mode attempting to apply increasing pull strength to the fine wire 18 and 18a. When the break point 39 is reached, the tool holder would rapidly accelerate in an upward

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direction unless the total force or current applied to the linear motor is reduced. Thus, anticipating point 39, the linear motor is placed in a position mode where the current applied along the curve shown at 41 is only sufficient to balance the bonding tool holder and transducer at a desired level position (see column 4 lines 37-63). The Applicant respectfully notes that Price teaches that the predetermined current strain relationship is utilized to incrementally apply predetermined forces or to inferentially estimate the force applied as a function of elongation measurements in a destructive or non-destructive pull test. Price does not teach or suggest direct force measurements by a wire bonder to facilitate and process changes of bonding parameters. Thus, the Applicant believes that claim 1-5, 8-10, 12-26, 29 and 30 are patentable under the requirements of 35 U.S.C. § 102(b) over the Price et al. reference.

The Examiner also rejects claims 1-4, 6-10, 12-26, 27, 28, and 30 under 35 U.S.C. § 102(b) as being anticipated by Kurtz et al. (U.S. Patent No. 4,597,519). The Applicant has carefully reviewed the Kurtz reference and respectfully disagrees with the Examiner's assessment of the teachings of Kurtz. More particularly, the Examiner asserts that at column 1, lines 19-30 Kurtz teaches a method of testing wire bond connections between a bonded wire and a pad on an electronic device formed in the conventional manner of heat or ultrasound wherein the method comprises lifting the bonding head after bond formation, gripping the wire with a clamp and raising the wire through a second distance during which process the force on the wire is detected. The Applicant finds absolutely no mention of a pull test in the cited description, and more particularly no description or suggestion of lifting the bonding head after bond formation, gripping the wire with a clamp and raising the wire through a second distance or any measurement of force.

Similarly, the Applicant finds absolutely no mention of distance or force measurement calculated by a computer program at the cited column 4 line 65 through column 5 line 18, or column 9 lines 40-68, or column 10 line 45 through column 11 line 51. Kurtz does disclose various apparatus and processes for controlling position and velocity of the bonding head, however makes no mention of force measurements. Further, the wire clamp is employed in formation of the wire bond, e.g., for breaking for subsequent bonds. The Applicant respectfully notes that Kurtz clearly does not disclose or suggest performing pull tests including tensile force measurements during the bonding process or utilizing the measured tensile forces for adjustment

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or change in bonding parameters as in the Applicant's claimed invention. The Applicant thus believes that claims 1-4, 6-10, 12-26, 27, 28, and 30 are patentable under the requirements of 35 U.S.C. § 102(b) over the Kurtz reference.

The Examiner also rejects claims 1, 4, 6-8, 12-16, 21, 23, 27, and 28 under 35 U.S.C. § 102(b) as being anticipated by Zimmerman (U.S. Patent No. 4,786,860). The Applicant has carefully review the Zimmerman reference and notes that Zimmerman is directed to a detection system and method for identifying missing or improper wire feed during a wire bonding process. Zimmerman utilizes an impedance signal of a transducer 14 to indicate whether force applied to the wire bonder corresponds to proper presence or absence of wire. The Zimmerman device generates an alert if sufficient force is not applied to alert an operator of the fault condition. The Applicant respectfully notes however that Zimmerman does not utilize force measurements for conversion into appropriate changes in bonding parameters of the wire bonder. Rather, Zimmerman simply performs a fault check for missing wire. The Applicant thus believes that claims 1, 4, 6-8, 12-16, 21, 23, 27, and 28 are patentable under the requirement of 35 U.S.C. § 102(b) over Zimmerman.

The Examiner also rejects claims 1-3 under 35 U.S.C. § 102(e) as being anticipated by Ikoma et al. (U.S. Patent No. 6,435,399). The Applicant has carefully reviewed the Ikoma reference and notes that Ikoma teaches apparatus and methods of checking wire bond integrity. The Ikoma apparatus and method is adapted for identifying faulty wire bonds which may arise when the wire bond is formed on a die that may be warped. The Ikoma device applies a downward force to form a wire bond and measures a first height H1. The Ikoma apparatus and method then applies an uplift force to the wire and measure a second height H2. A comparison is made between the first and second heights, H1, H2. Any difference between H1 and H2 is compared to a threshold to discriminate between bonds which may have been formed in a faulty manner. The Applicant respectfully notes however that Ikoma is configured to apply a predetermined force insufficient to break the wire in performing the second height measurement for H2 but does not disclose or suggest actual measurements of force applied as in the Applicant's claimed invention. Ikoma also fails to disclose or suggest utilizing a measured tensile force for conversion into appropriate changes in bonding parameters as in the Applicant's

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claimed invention. Thus, the Applicant believes that claims 1-3 are patentable under the requirements of 35 U.S.C. § 102(e) over the Ikoma reference.

The Examiner also rejects claims 6, 7, 11, 27, 28, and 31-33 under 35 U.S.C. § 103(a) as being unpatentable over Price et al. in view of Ringler et al. (U.S. Patent No. 6,439,448) and Mayer (U.S. Patent No. 4,895,028). Following a careful review of the Ringler '448 reference, the Applicant notes that Ringler teaches an ultrasonic wire bonder for large wire having improved flexural support for the bonding elements with an improved wire clamp and wire guide and further including an active laterally-moving cutter for the wire. More particularly, the flexure assembly comprises an outer ring or supporting spring flexure formed of multiple arcuate arms and an inner cylinder portion supported on the arcuate arms. The inner portion supports the active components of the wire-bonding elements. The support of the bonding elements on the circular ring creates an improved spring decoupling function while at the same time reducing lateral displacement and eliminating friction. Further improvements include the use of a fillet at the connection point of the spring members or arcuate arms to reduce fatigue, and a pocket into which they can bend or flex. Ringler '448 teaches "An opening 16 is shown within the bonding head which receives the cable guide 18 having cables 20 which serve the electronic and control functions of the bonding head. ... "In order to drive the bonding tool and other elements with sufficient force against the work to be bonded, a forcer assembly 34 is shown. The forcer magnetically drives the bonding tool into forced relationship on the work at a pre-established or desired level of force." Ringler teaches several advantages of the aforementioned flexure assembly with arcuate arms and fillets as well as clamps 210 and 212 to perform a clamping function. Ringler '448 teaches that the clamps 210 and 212 are arranged to facilitate movement of a cutter blade 270 into close proximate relationship with the end or tip 282 of the bonding tool 278 to provide for the closest practical cut off of the wire that has been bonded near the tip 282.

The Applicant respectfully notes however that Ringler '448 lacks any teaching of force measurement and in particular clearly lacks the aspects of the Applicant claimed invention of "raising the bonding head or the wire clamp with bonding wire gripped therein for a second distance during which process the tensile force acting on the bonding wire is measured" (Claim 1 as currently amended) as well as "a wire bonder...wherein a force measuring device is associated with the wire clamp holder in order to measure a tensile force acting on a bonded connection to

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the bonding wire that has been produced” (Claim 4 and 21 as currently amended). The Applicant thus believes that the base claims 1, 4, and 21 as well as the claims depending therefrom are patentable under 35 U.S.C. § 102(b) over Ringler.

The Applicant has also carefully reviewed the Mayer reference and notes that Mayer teaches apparatus and methods for performing pull tests on formed wire bonds. Mayer clearly however fails to disclose a wire bonder and more particularly, a wire bonder including capability to perform in process force measurements and conversion of said force measurements into appropriate changes and bonding parameters. Rather, Mayer solely discloses a separate wire bond tester that is not incorporated within a wire bonder device. Thus, as previously discussed with respect to the teachings of Price and Ringler, the Applicant believes that claims 6, 7, 11, 27, 28, and 31-33 are patentable under the requirements of 35 U.S.C. § 103(a) over the Price reference in view of Ringler and Mayer.

The Examiner also rejects claims 11 and 31-33 under 35 U.S.C. § 103(a) as being unpatentable Kurtz et al. in view of Ringler and Mayer. As previously discussed, the Applicant believes that neither Kurtz nor Ringler or Mayer reasonably teach or suggest the Applicant’s claimed invention. The Applicant further believes that even when taken in combination, Kurtz, Ringler and Mayer still fail to disclose or reasonably suggest the Applicant’s claimed invention. Thus, the Applicant believes that claims 11 and 31-33 are patentable under the requirements of 35 U.S.C. § 103(a) over Kurtz in view of Ringler and Mayer.

The Applicant would like to emphasize that the advantages of the claimed invention are not only providing a system and a method for in process testing of wire bonds, but also comprise the possibility of a real-time quality control and the immediate execution of quality-ensuring adjustment procedures via force measurement of the formed bonds (claims 4 and 21 as currently amended). Hence, the Applicant strongly believes that these features provide significant novel and inventive advantages to the field which are clearly neither anticipated nor rendered obvious by the combined art of record.

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SUMMARY

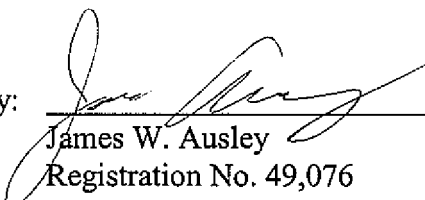
The Applicant thus believes that the subject application is in a condition ready for allowance and respectfully requests prompt issuance of a notice of allowability. The Applicant believes that this paper fully addresses the objections made by the Examiner in the Office Action, however should there remain any further impediment to the allowance of this application that might be resolved by a telephone conference, the Examiner is respectfully requested to contact the Applicant's undersigned representative at the indicated telephone number.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

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Dated: September 14, 2006

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